PRE-HOSPITAL USE OF BLOOD COMPONENTS (RED CELLS AND PLASMA)

Anatolij Truhlář[1,2], Vít Řeháček[3] a kol.

[1] Emergency Medical Services of the Hradec Králové Region, Helicopter Emergency Medical Service "Christoph 6" Hradec Králové, Czech Republic

[2] Department of Anaesthesiology and Intensive Care Medicine, Charles University Prague, Faculty of Medicine Hradec Králové, University Hospital Hradec Králové, Czech Republic

[3] Transfusion Department, University Hospital and Faculty of Medicine Hradec Králové, Czech Republic

EUROPEAN RESUSCITATION COUNCIL

Conflict of interest

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

European Resuscitation Council Guidelines for Resuscitation 2015
Section 1. Executive summary

Koenraad G. Monsieurs[a,b,*], Jerry P. Nolan[c,d], Leo L. Bossaert[e], Robert Greif[f,g], Ian K. Maconochie[h], Nikolaos I. Nikolaou[i], Gavin D. Perkins[j,p], Jasmeet Soar[k], Anatolij Truhlář[l,m], Jonathan Wyllie[n], David A. Zideman[o], on behalf of the ERC Guidelines 2015 Writing Group[1]

European Resuscitation Council Guidelines for Resuscitation 2015
Section 4. Cardiac arrest in special circumstances

Anatolij Truhlář[a,b,*], Charles D. Deakin[c], Jasmeet Soar[d], Gamal Eldin Abbas Khalifa[e], Annette Alfonzo[f], Joost J.L.M. Bierens[g], Guttorm Brattebø[h], Hermann Brugger[i], Joel Dunning[j], Silvija Hunyadi-Antičević[k], Rudolph W. Koster[l], David J. Lockey[m,w], Carsten Lott[n], Peter Paal[o,p], Gavin D. Perkins[q,r], Claudio Sandroni[s], Karl-Christian Thies[t], David A. Zideman[u], Jerry P. Nolan[v,w], on behalf of the Cardiac arrest in special circumstances section Collaborators[1]

Pilot project in the Czech Republic

RABBIT

RAPID ADMINISTRATION OF BLOOD BY HEMS IN TRAUMA

Pre-hospital transfusion in HEMS

2017: No. of patients treated by HEMS 578

HEMS primary missions 95,9 %

81,9 % HEMS activations decided by medical dispatchers

Severe trauma patients

373 patients (64,5 % HEMS missions)

Multiple trauma 117

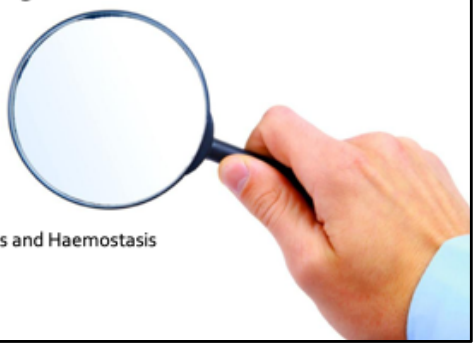
Traumatic brain injury (TBI) 24, spinal trauma 2, burns 39

Trg+ patients 224

Trama centre as an admitting facility 240

Content of the lecture

- **RABBIT trial protocol**
- **Experience after 5 months of pre-hospital use of blood components**
  - How accurate is HEMS in recognition of life-threatening haemorrhage#?
  - Aren't medical teams "playing" with blood too long?
  - How much waste does it all generate?
  - And some preliminary results from hospital



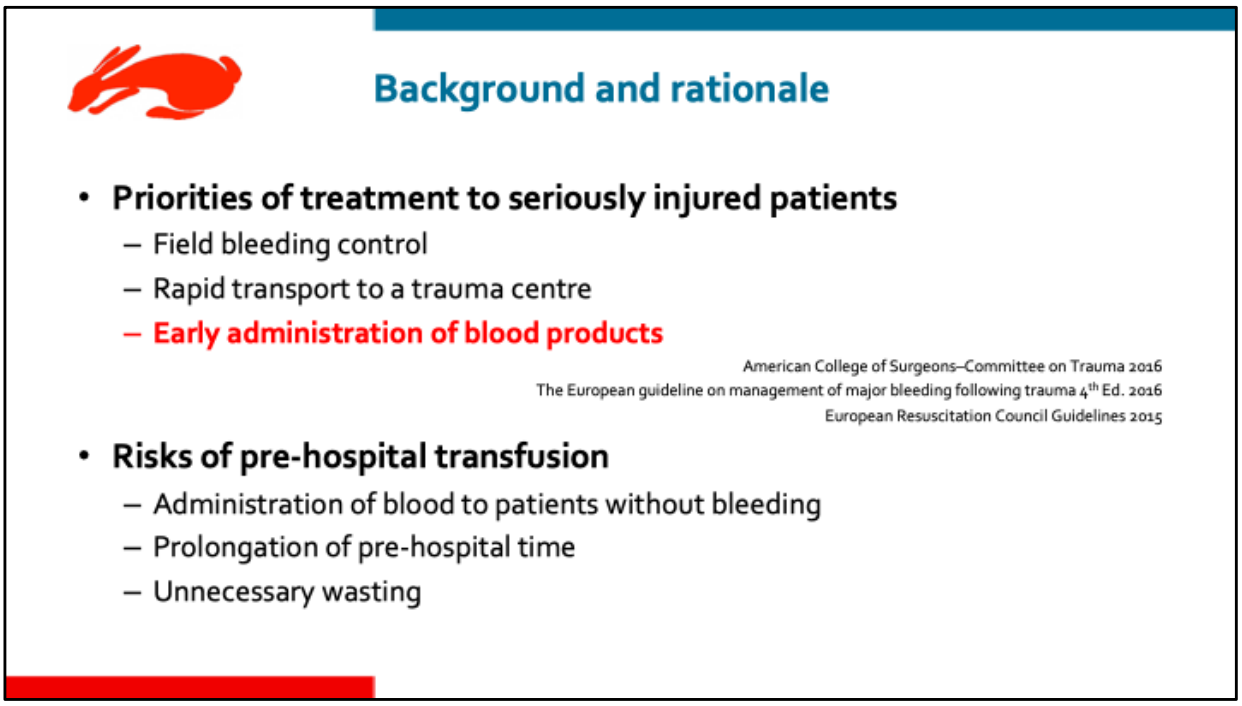
#Definition based on a consensual statement of the Czech Society for Thrombosis and Haemostasis

Aetiology of traumatic cardiac arrest (TCA): 48% hypovolaemia (bleeding)
Consensual statement of the Czech Society for Thrombosis and Haemostasis

- ztráta objemu krve během 24 hodin
- ztráta 50 % objemu krve během 3 hodin
- pokračující krevní ztráta přesahující 150 ml/hod
- krevní ztráta v lokalizaci vedoucí k ohrožení vitálních funkcí
- přítomnost klinických a laboratorních známek tkáňové hypoperfuze nebo poruchy orgánových funkcí v průběhu krvácení

Absolutní indikace pro přednemocniční transfuzi byla navíc potvrzena pokračováním MTP v časné nemocniční fázi a potřebou tzv. damage control surgery (operační nebo radiointervenční výkon) okamžitě po přijetí

Krystaloidy: hemodiluce, koagulopatie, acidóza, vaskulární změny
Erytrocyty a plazma aplikovaná optimálně od 30. minuty od úrazu zajistí objemovou náhradu, zvýší transportní kapacitu krve pro kyslík a částečnou substituci koagulačních faktorů (I = fibrinogen, II, VII, IX, X, XII)



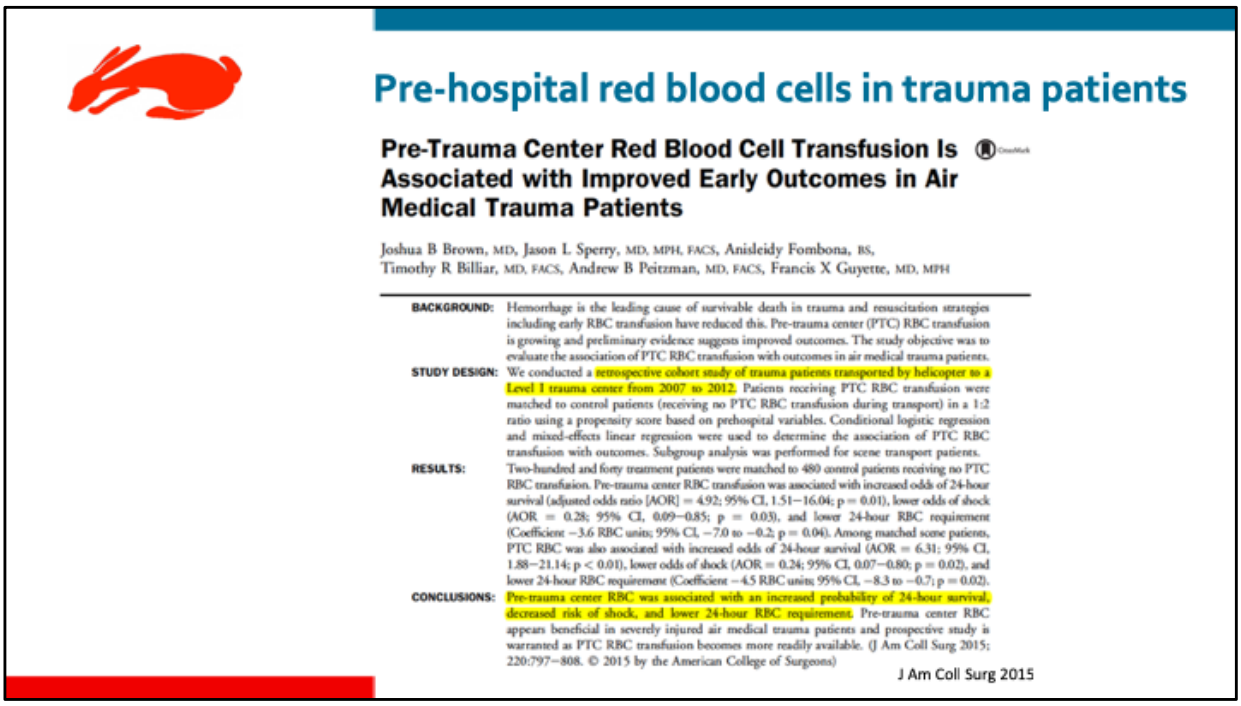
Úzká spolupráce ZZS s traumacentra (TC) od vzniku regionálního traumasystému v roce 2004

1) strukturované předávání informace do TC,
2) aktivace masivního transfuzního protokolu (MTP) lékařem LZS z terénu již déle než 10 let

History of pre-hospital transfusion

Dak To, Vietnam, 27 November 1967

PHBP were used during the Vietnam War
Civilian prehospital PRBC administration reported in 1985, Oregon, USA



Pre-hospital red blood cells in trauma patients

Pre-Trauma Center Red Blood Cell Transfusion Is Associated with Improved Early Outcomes in Air Medical Trauma Patients

Joshua B Brown, MD, Jason L Sperry, MD, MPH, FACS, Anisleidy Fombona, BS, Timothy R Billiar, MD, FACS, Andrew B Peitzman, MD, FACS, Francis X Guyette, MD, MPH

BACKGROUND: Hemorrhage is the leading cause of survivable death in trauma and resuscitation strategies including early RBC transfusion have reduced this. Pre-trauma center (PTC) RBC transfusion is growing and preliminary evidence suggests improved outcomes. The study objective was to evaluate the association of PTC RBC transfusion with outcomes in air medical trauma patients.

STUDY DESIGN: We conducted a retrospective cohort study of trauma patients transported by helicopter to a Level I trauma center from 2007 to 2012. Patients receiving PTC RBC transfusion were matched to control patients (receiving no PTC RBC transfusion during transport) in a 1:2 ratio using a propensity score based on prehospital variables. Conditional logistic regression and mixed-effects linear regression were used to determine the association of PTC RBC transfusion with outcomes. Subgroup analysis was performed for scene transport patients.

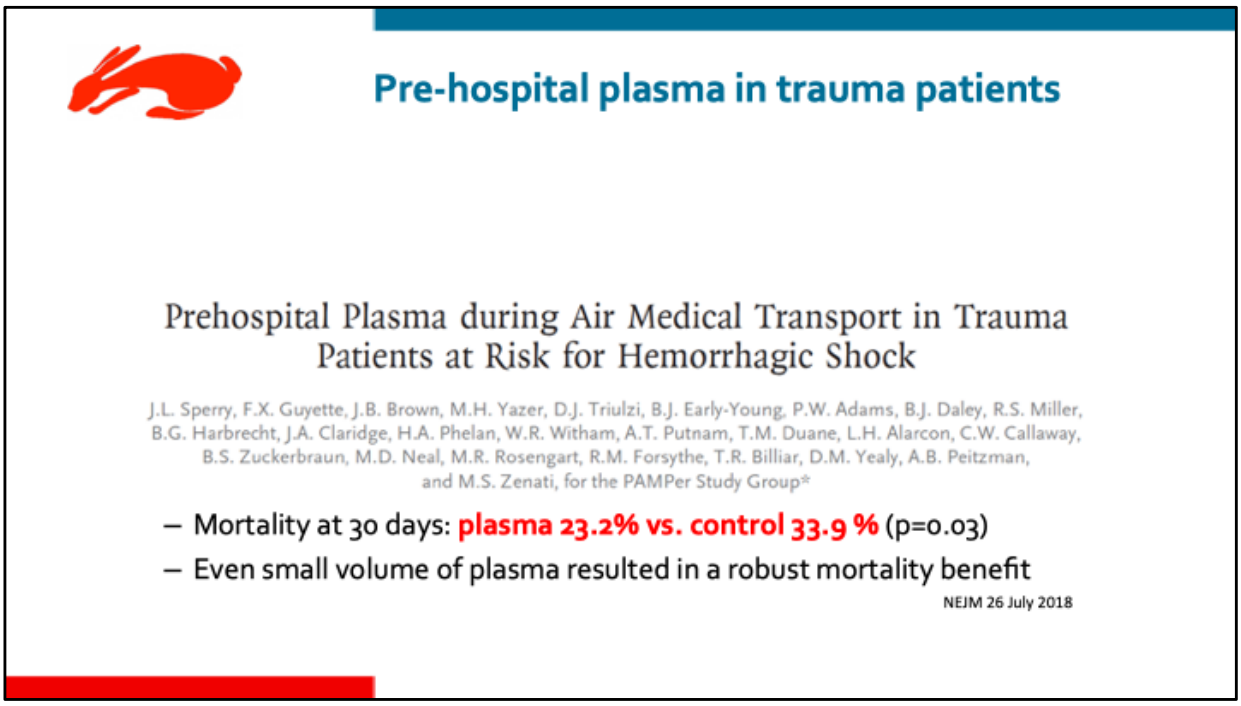
RESULTS: Two-hundred and forty treatment patients were matched to 480 control patients receiving no PTC RBC transfusion. Pre-trauma center RBC transfusion was associated with increased odds of 24-hour survival (adjusted odds ratio [AOR] = 4.92; 95% CI, 1.51–16.04; p = 0.01), lower odds of shock (AOR = 0.28; 95% CI, 0.09–0.85; p = 0.03), and lower 24-hour RBC requirement (Coefficient −3.6 RBC units; 95% CI, −7.0 to −0.2; p = 0.04). Among matched scene patients, PTC RBC was also associated with increased odds of 24-hour survival (AOR = 6.31; 95% CI, 1.88–21.14; p < 0.01), lower odds of shock (AOR = 0.24; 95% CI, 0.07–0.80; p = 0.02), and lower 24-hour RBC requirement (Coefficient −4.5 RBC units; 95% CI, −8.3 to −0.7; p = 0.02).

CONCLUSIONS: Pre-trauma center RBC was associated with an increased probability of 24-hour survival, decreased risk of shock, and lower 24-hour RBC requirements. Pre-trauma center RBC appears beneficial in severely injured air medical trauma patients and prospective study is warranted as PTC RBC transfusion becomes more readily available. (J Am Coll Surg 2015; 220:797–808. © 2015 by the American College of Surgeons)

J Am Coll Surg 2015

University of Pittsburgh Medical Center (UPMC) Presbyterian Hospital, an urban Level I trauma center with the highest volume of trauma patients in the state of Pennsylvania.

STAT MedEvac is a large HEMS provider managed through the University of Pittsburgh's Center for Emergency Medicine, and accounts for approximately 40% of Pennsylvania's HEMS transports. During the study period, STAT MedEvac was staffed by a paramedic/nurse team and carried 2 U type O negative RBCs on each mission.



PAMPer trail (Prehospital Air Medical Plasma)
Pragmatic, multicenter, cluster-randomized, superiority trial at the University of Pittsburgh ➔ air medical transport **from the scene OR from an outside referral ED (approx. 22 %)** to the trauma center
501 pts in haemorrhagic shock (SBP ≤70 mm Hg or 71–90 mm Hg plus HR ≥108 per min) ➔ **age 45 years**
n=230 plasma (treatment) vs. n=271 standard care (control)
Transport times: plasma 42 min [IQR 34–53] vs. control 40 min [33–51]
Mortality at 30 days: plasma 23,2 % vs. control 33,9 % (p=0,03)
Lower median prothrombin time ratio in plasma group (p<0,001)
Even small volume of plasma resulted in a robust mortality benefit
Reduction in bleeding or coagulopathy, inflammatory response or endothelial dysfunction of trauma
Differences in the volume of prehospital crystalloid solution and in the percentage of patients who received red-cell transfusion

London, United Kingdom

London since March 2012

Billund, Denmark

Hradec Králové, Czech Republic

Battery-powered blood warmer

What are our expectations?

- **Lower 24-hour blood product requirements**
- Lower severity of trauma-induced coagulopathy (INR, ROTEM) and traumatic-haemorhagic shock (lactic acid, organ failure)
- Confirmation of feasibility (blood products wastage < 1%)
- Confirmation of safety (adverse events, pre-hospital time)
- **Higher quality of care delivered by HEMS**

Project administration

- **University Hospital ethics committee approval:** 201606 S13P
- **Agreement of all participating organisations and in-hospital departments**
  - Level I Trauma Centre at the University Hospital Hradec Králové
  - Dept. of Emergency Medicine, Transfusion Dept., Dept. of Anaesthesiology and Surgery
- **Approval from regional government responsible for EMS**
- **Trial registration at ClinicalTrials:** NCT03522636
- **State Institute for Drug Control approval on out-of-hospital use of blood**
  - Validation of "Credo S4 EMT" storage boxes
  - Effect of vibrations during helicopter transport on RBCs quality
  - Process of defrosting and subsequent cooling of plasma to 4 °C
  - New SOPs and documentation (e.g. process of exchange between HEMS and hospital, blood products packing, temperature monitoring, transfusion protocols)

Enrolement process

SOP for pre-hospital use of blood components

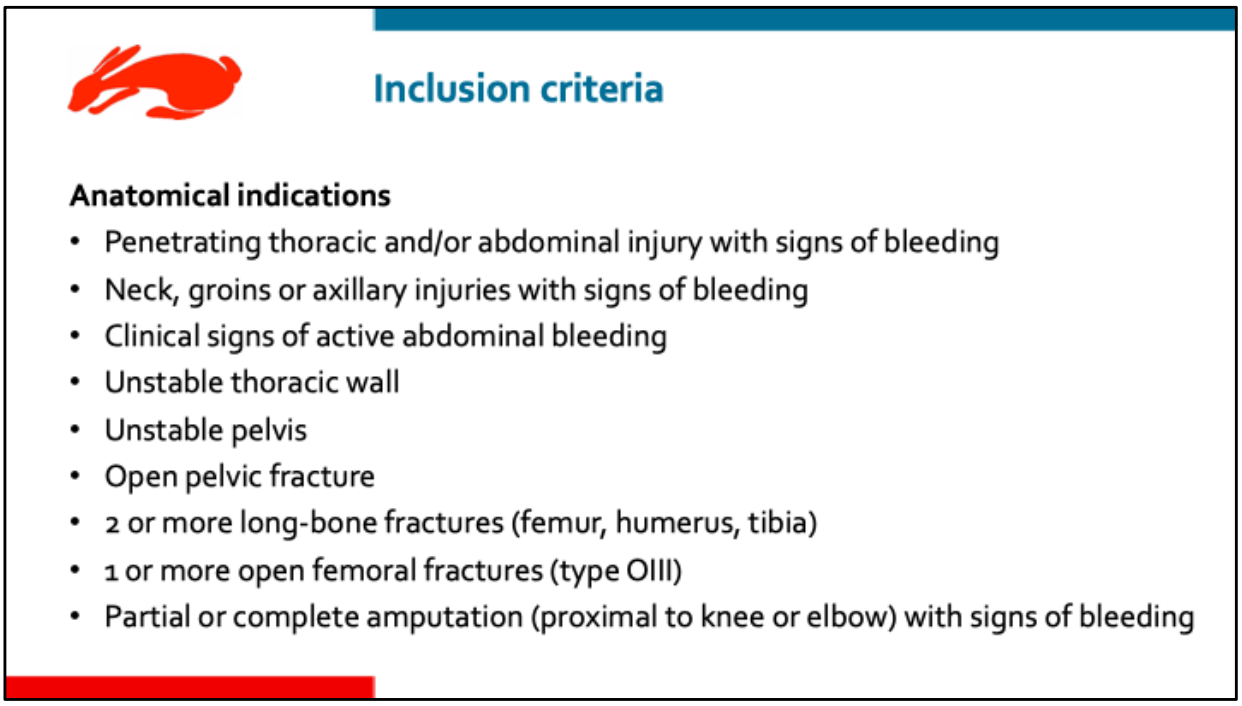
- Seriously injured patient
- Vital indication for transfusion by attending HEMS physician
- Pre-hospital treatment: 1 unit of plasma ➔ 1 unit of RBC ➔ 1 g TXA
- All other key treatment principles have to be assured!

Cílový poskytovatel zdravotních služeb
Traumacentrum (TC) Fakultní nemocnice Hradec Králové
Pracovníci TC jsou o možnosti přednemocniční aplikace TP informováni a tento postup plně akceptují!

Inclusion criteria

Physiological indications

- Absent radial pulse
- Hypotension with systolic blood pressure < 100 mmHg



Typ OIII: silně kontaminovaná rána, rozsáhlé zhmoždění měkkých tkání, nervové a cévní léze

Inclusion criteria

Mechanism of injury[+]

- Prolonged extrication (thorax, abdomen, pelvis)
- Fall > 6 m (verification by HEMS physician needed)
- Vehicle run over (thorax, abdomen, pelvis)
- Impact of a heavy object or animal (thorax, abdomen, pelvis)

[+]Mechanism of injury (MOI) has to be associated with anatomical and/or physiological changes. Inclusion criteria for pre-hospital transfusion are different from trauma triage criteria selecting patients for primary transportation to a trauma centre.

Exclusion criteria

Absolute contraindications

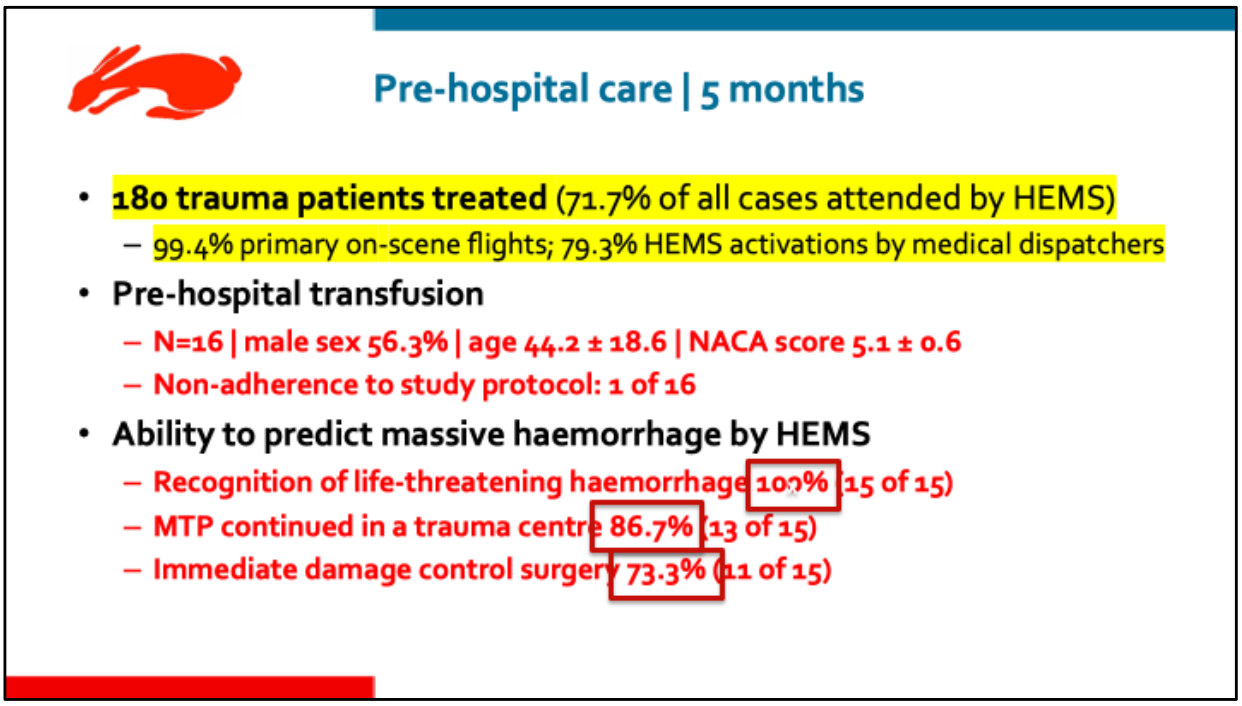
- Traumatic cardiac arrest before administration of blood products[+]

[+]Sustained or intermittent ROSC after resuscitation for TCA is not exclusion

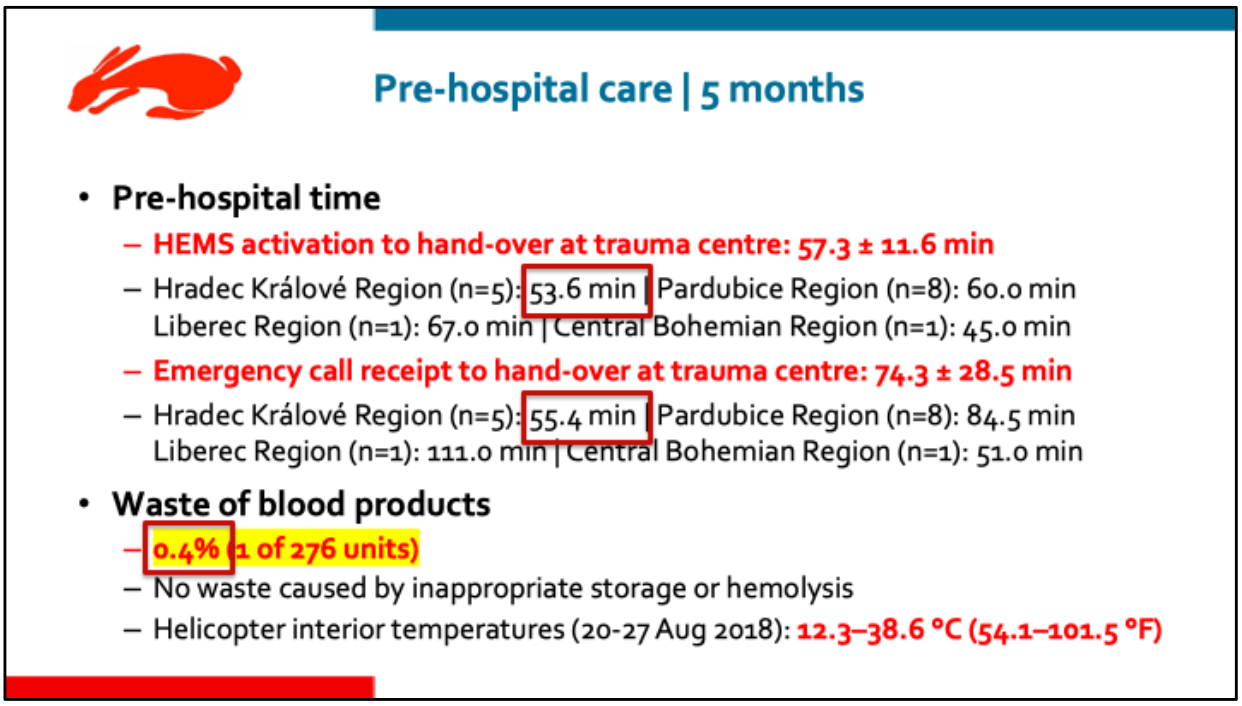
Relative contraindications

- Isolated TBI without evidence of external haemorrhage or bleeding
- Admitting hospital other than University Hospital Hradec Králové
- Age < 18 years[+]

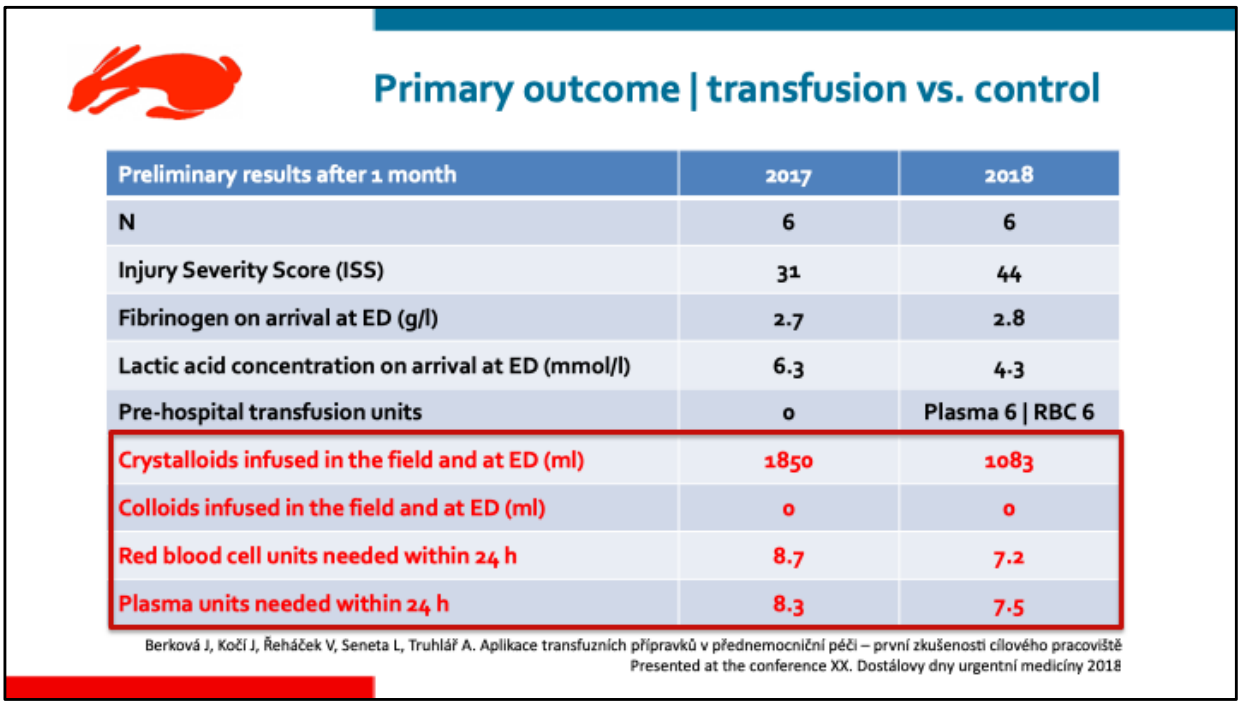
[+]Administration of pre-hospital transfusion in children can be decided as a "rescue strategy"



DOPLNIT POČET ZÁSAHŮ ZA ŘÍJEN 2018 A ZMĚNIT PROCENTA
1.6.–30.9.2018: n=16 (8,9 % ošetřených traumat)
Hypotenze s nehmatným pulzem na radiální tepně se vyskytovala u všech pacientů (n=15)
251 ošetřených pacientů za 4 měsíce, z toho 180 úrazů
Poslední podané transfuze: 3.9.2018 a 10.11.2018 (stav k 13.11.2018)
Nedodržení protokolu: 1 ze 16 (motocyklista po čelním střetu s osobním autem s KCP a otevřenými zlomeninami obou předloktí)



DOPLNIT POČET VYDANÝCH JEDNOTEK ZA MĚSÍC ŘÍJEN 2018 A ZMĚNIT PROCENTA ZNEHODNOCENÝCH TP



Primary outcome | transfusion vs. control

Preliminary results after 1 month	2017	2018
N	6	6
Injury Severity Score (ISS)	31	44
Fibrinogen on arrival at ED (g/l)	2.7	2.8
Lactic acid concentration on arrival at ED (mmol/l)	6.3	4.3
Pre-hospital transfusion units	0	Plasma 6 | RBC 6
Crystalloids infused in the field and at ED (ml)	1850	1083
Colloids infused in the field and at ED (ml)	0	0
Red blood cell units needed within 24 h	8.7	7.2
Plasma units needed within 24 h	8.3	7.5

Berková J, Kočí J, Řeháček V, Seneta L, Truhlář A. Aplikace transfuzních přípravků v přednemocniční péči – první zkušenosti cílového pracoviště
Presented at the conference XX. Dostálovy dny urgentní medicíny 2018

Medián věku byl v roce 2017 59,9 roku (v rozmezí 39-74 let), v roce 2018 53,7.

Ve sledovaných laboratorních parametrech nebyl pozorován rozdíl mezi průměrnými hodnotami fibrinogenu, ani laktátu.

Vstupní SOFA (sequential organ failure assessment) skóre se meziročně nelišilo.

V každé skupině zemřel během prvních 30 dnů od přijetí 1 pacient.

U všech pacientů v obou skupinách byl aktivován masivní transfuzní protokol a následovala léčba v souladu s postupy tzv. damage control surgery (urgentní operační nebo radiointervenční výkon). Na OUM bylo podáno průměrně o 500ml krystaloidů méně, žádný koloid. MAP se nelišil, vazopresorickou podporu měli v obou skupinách 2 ze 6 pacientů.
Průměrné množství transfuzních přípravků podaných během prvních 24 hodin bylo ve skupině 2018 nižší o 1 transfuzní jednotku (TU) erytrocytů, 1 TU plazmy a 0,5 terapeutické dávky trombocytů.

Summary

- Pre-hospital transfusion has become routine element of trauma care provided by HEMS
- HEMS personnel was able to recognize life-threatening haemorrhage in all cases; 87% patients treated with blood required MTP
- Quality assurance for every single case needed!
- More survivors? At least some chance...

Přednemocniční aplikace transfuzních přípravků s následným MTP v traumacentru vedla ke snížení celkového množství krystaloidních roztoků a počtu transfuzních přípravků podaných v prvních 24 hodinách od úrazu. Zkušenosti z úvodního měsíce pilotního projektu RABBIT podporují předpoklad zlepšení kvality péče o závažně poraněné pacienty, což umožňuje další používání zavedeného protokolu beze změn.
Quality assurance and feedback for every single case needed!

Anatolij Truhlář, MD, PhD, FERC
@TruhlarA | truhlaran@zzskhk.cz